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EXTENSION DIVISION
UNIVERSITY OF UTAH



THE KINGDOM OF MAN

BY

RALPH VARY CHAMBERLIN

Professor of Biology
University of Utah



*The Second Annual Frederick William Reynolds
Memorial Lecture*

*Delivered at the University of Utah
January 20, 1938*

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PREFATORY NOTE

The following lecture by Dr. Ralph Vary Chamberlin is the second in a series initiated by a memorial association founded in 1936 to perpetuate the memory of the late Frederick William Reynolds.

As the organizer and first director of the University of Utah Extension Division, F. W. Reynolds had probably sponsored more public lectures of importance than any other person in the state. It is also safe to assume that no one on the faculty had been more stimulating to his associates in the field of public lectures and discussion. No attainable memorial seemed so fitting, therefore, as a permanent lectureship—with the speaker chosen annually from the University faculty.

In 1937 an agreement was entered into between the University and the Memorial Association providing for:

An annual lecture on the University Campus by a member of the Faculty, on a topic chosen by him and arising out of his research or thought, which shall make available to the public some important accomplishment in the field, or the results of some distinctive body of knowledge.

The lecturer to be chosen by a committee constituted as follows: The Director of the Extension Division, a member of the Board of Regents appointed by the Chairman of the Board, a member of the Faculty appointed by the President of the University, the President of the Alumni Association, and the President of the Student Body.

The lecture, a pretentious and important yearly offering of the University, to be free to the public.

The University and its Extension Division have generously responded to a widespread public request by sponsoring the publication of this Bulletin. Acknowledgment and appreciation are graciously extended to President George Thomas, the Board of Regents and the Extension Division for this response, and for their very substantial contribution to the entire enterprise.

H. L. MARSHALL

*President, Frederick William Reynolds
Memorial Association*

FOREWORD

The distinctive feature of modern times is that the world, both in its material and in its personal aspects, is in a state of increasingly rapid transition. The time span of important changes has been so much shortened that it becomes ever more difficult to enjoy the illusion of fixed conditions. Almost before our eyes, time-honored beliefs, customs and institutions are dissolving or being so transformed as to leave only the superficial semblance of the earlier state. The marked differences in the rates of change in various fields and phases of life have resulted in serious disharmonies that have made the practical problem of personal conduct and social adjustment increasingly difficult. The era of change, furthermore, is no temporary phase in the history of thought and may be expected to continue at an increasing tempo.

The characteristic changes of modern times,—those that have largely confirmed in the minds of men the idea of progress so wholly lacking in ancient and mediaeval thought,—have risen entirely during the three centuries since the emergence of science. The theme of the present lecture is that since the growth of science has been clearly the true and ultimate source of the creative impulses making for change, and the basis of man's increasing achievements in control, the fundamental need in the world today is for the wide and thorough diffusion of a knowledge of the nature of the revolution that is taking place and of the scientific method and spirit.

The time is ripe for a full realization of this role of science in our civilization and of the major results it has reached, especially those now so clearly demonstrated as to the true relation of man to Nature. Such knowledge must soon be made the basis and guide in planning for social development and government, if we are to avoid ultimate catastrophe. Such procedure would abate many persistent evils that now flow from neglect of this knowledge, such as those resulting from futile efforts made under the perennial illusion that progress depends upon economics and social regulations. The habit of a scientific attitude and approach, in place of emotionalism, among a larger proportion of the people would be the only effective defense against insidious propaganda and falsification and thereby a preventive against the ceaseless repetitions of "the struggle to liberate mankind from the clutches of its most recent liberators, crowd devouring crowd, mass movements marching to Utopia down blind alleys."

R. V. CHAMBERLIN

University of Utah,
February, 1938.

THE KINGDOM OF MAN

INTRODUCTION



HERE is much in the stirring world scene of today to justify the definition of man as the animal who spends sixteen hours a day in mischief and only eight hours a day in innocence. Certainly a detached survey reveals a none too creditable history. He has been throughout an aggressively selfish creature continuously engaged in raising Gehenna for himself and all creation; for, not content with dominion over the beasts of the field and the fowl of the air, he long ago began preying on his own fellows on the principle that it is easier to seize power and wealth than to create them. Yet a quality of altruism, paradoxically enough, early grew out of man's selfishness when he found that in union there is strength.

After developing a settled manner of life, his evolution became a social process in which there is need for the social virtues. From that time on his life has been involved in a struggle, periodically violent, between the primeval urge of brute predaciousness and the humane, benevolent impulses engendered by social experience and struggle. Hence, as Louis Pasteur once said: "Two opposing laws seem today to be in combat—a law of blood and death, which, daily devising new weapons of war, compels the people to be prepared always for the battlefield; and a law of peace, work and welfare, which is concerned only with the delivery of humanity from the scourges which beset it. The one seeks only violent conquests; the other the relief of mankind. The one places a human life above all victories; the other would sacrifice hundreds of thousands of lives to the ambition of one man."

Since the achievement of group coherence, the forces of human evolution have acted on the social organism rather than upon the individual, and the products have been in the main such social media as ideas, opinions, habits, relations, traditions and institutions. Biologically speaking, ideas and beliefs have various sorts of utility aside from any question of their objective validity or truth, an important one being the securing of group cohesion and mass action. Historically, people have preferred the security or stability of being one with the group, and there has been, along with a ready credulity, the age-old disposition to assign divine sanction to traditional beliefs and customs. The agency of ideas and beliefs, therefore, has proved a means of power wielded by leaders more potent beyond comparison than all the agencies at the disposal of individual man.

Through many centuries of human history ideals of justice and brotherly love have so influenced the activities of men that we have seemed at times about to enter the millenium, only to witness the disintegration of this altruism under political and economic stress. When a leader or ruler abandons these ideals, however, he commonly feels bound to give to his action the flavor of morality. "Man must convince himself that he can rape in right-

eousness and murder in magnanimity. He insists on playing the game, not only with an ace up his sleeve, but with the smug conviction that God has put it there." History is filled with instances comparable with that of Japan, among whose people the argument prevails today that since Japan has the only divinely established government, and is governed by a living deity, it is her manifest right and duty to rule the world. The defenders of slavery rarely admitted that they favored the system because it was profitable; they argued rather that it was better for the slave, that they were executing the will of God, or serving the best interests of the country. Man would seem to be the only creature who through superior intelligence is able to persuade himself that things are not as they are but as he wishes them to be.

But the really great game man has had to play has not been within his own ranks, where subtle acts of intellectual deception and propaganda have often prospered; it has been an incessant one with Nature who from time to time chastens him and restores his sanity by bringing him back to earth. For Nature can be neither deceived nor wheedled. Her ways are set, her justice even and dependable but adamant. Hence the greatest effort of thinking man since the beginning of history has been to find a reasonable set of answers to his own questions about the nature of the world and his place in it. His fundamental beliefs as to these questions have been the great moving forces behind all his activities and with them all subsidiary thought systems, inclusive of the explanations and extensions made in the interests of authority and institutions, have had to harmonize. The significant processes of human life consist in the passage from one thought system to another, and the true history of mankind is the history of ideas. Emerson once wrote: "Beware when the great God lets loose a thinker upon this planet. Then all things are at risk. There is not a piece of science but its flank may be turned tomorrow; there is not any literary reputation that may not be revised and condemned. The very hopes of man, the religion of nations, the manner and morals of mankind, are all at the mercy of a new generalization."

The basic idea that has determined our modern civilization and set it off from all others is the scientific idea. This is unquestionably the age of science; but if we have in mind the people rather than the movement, this statement must be strongly qualified. Our age stands for certain achievement, for a certain mentality which few of us exhibit. It is remarkable that so few even among scientists themselves maintain the scientific attitude outside their own limited subjects, but in such fields as religion, morals and politics reveal an extraordinary inertia of early habit. Scientific beliefs, that is, beliefs we have some reason to hold because of an evidenced relationship to reality, are all too rare among the general run of humanity. Most beliefs have come through contagion and involve reason only by way of apology or justification.

The mass and influence of these apologies and rationalizations are so vast and they are involved with emotions so overwhelming that modernity appears as little more than a veneer, a veneer laid on prejudices proceeding, not from primal human nature itself, but from deliberately inculcated educations intended to produce men of some special creed or type. In fact, it has been said, "Every phase of evolution from the Stone Age onward is repeated in the population of the twentieth century world. Victorians, Tudorians, ghosts surviving from the Middle Ages, and multitudes whose minds properly belong to paleolithic times, far outnumber the people who truly appertain to the twentieth century." Never at any one time before has there been such a wealth of mutually contradictory beliefs and opinions. A common resultant attitude is expressed in Mr. Dooley's hibernicism: "One man's opinion is as good as another's, or even better." Some take the position of the Chinese laundryman who during a time of strife between Romanists and Orangemen placed this sign in front of his shop: "Me no religion at all, me only wash clothes."

In spite of the resistance opposed by the preponderance of contradictory systems of thought, science has transformed the world because it has been able continuously to justify itself by its works. Men may and do ignore logic, but they cannot long ignore the compulsion of concrete events and demonstrations. Science has made our civilization, as manifested in material things, in progressive thought, in individual and social emancipation, and especially in all that falls under the heading of rational control. By the free and confident use of his own intelligence man has succeeded in devising a control over the conditions of his existence quite unthinkable in earlier times. His achievements in many ways far transcend the situation in the *Regnum hominis* or Kingdom of Man foreseen by Francis Bacon and vividly pictured by him to an incredulous age. Today the physical difficulties, the lack of exact, usable knowledge and of self assurance, which necessarily prevented the practical realization of Bacon's schemes, have all been overcome.

And yet civilization faces a crisis. The social situation today to some men, such as Professor Einstein, reveals unmistakable signs of degeneration and decay. However interpreted, it is so obviously one of general confusion, instability, and widening conflict, both between and within nations, and the immediate future is so beclouded, that the need of an early, coherent evaluation of man's nature and behavior is insistent if we are to turn from a course which, in spite of our invincible American optimism, some able thinkers believe is leading toward the greatest tragedy in the history of mankind—the end of modern civilization.

For this perilous situation science itself has been widely blamed. My thesis is that the profound and tragic difficulties in the world today result from man's failure to extend science and the scientific attitude far enough, especially to himself and his immediate affairs, where he finds great difficulty in disentangling his intelligence from his hopes. Not too much science but too little science is at the root

of our troubles. We have spent much effort and wealth upon the science of matter; but the greater our success here, the greater must be our failure unless we, at long last, make a corresponding advance in the science of man. Man has proceeded so far in his interference with extra-human nature, he has produced for himself such a special state of things by his successful defiance of Nature's earlier dispositions, that he must go on and acquire still firmer control of conditions or perish miserably by "the vengeance certain to fall on the half-hearted meddler in great affairs."

Man has in many respects abrogated the laws of Nature by which he was formerly restrained; but along with the advantages he has thereby gained, he has opened himself to new dangers and disasters on every side. These perils already make him wince, and there are many who, blaming science and the machine age, openly suggest a return to a simpler life. But such reversal is impossible. As Bertrand Russell notes, Lao-Tze, said to have lived before Confucius in the 6th century B. C., "is just as eloquent as Ruskin on the subject of the destruction of ancient beauty by modern mechanical inventions. Roads and bridges and boats filled him with horror because they were unnatural; he speaks of music as modern high-brows speak of the moving-picture. He objects to the taming of horses, and to the arts of the potter and carpenter." Return to Nature, if taken as meant by Lao-Tze, "would involve the death by starvation of some 90 per cent of the population of civilized countries. Industrialism as it exists at the present day undoubtedly has grave difficulties, but they are not to be cured by a return to the past." The liquidation of the older order of life is irrevocable.

THE ORIGIN OF SCIENCE

The idea that was finally to flower in the scientific method issued from the Ionian Greeks whose minds developed not so much because of their innate superiority as because circumstances conspired to make them intellectually the freest people of whom we have record. This idea is simply that Nature is a world of system and order comprehensible to the rational mind and that Nature itself constitutes the ultimate standard or authority for belief. The power of rational thought depends upon two elements, its method and its data, and in the end the Greek missed science because he slighted the second element. He failed to see, except spasmodically, the point at which philosophic speculation so far outruns fact as to become unprofitable. He did not acquire a solid anchorage in concrete knowledge in time to save his world, but he gave the intellectual impulse that was to determine the mind of Europe and remake the world through science.

Historically the stream of rational thought from Greek philosophy divided, one branch running through Rome, the other through Alexandria. In the first, the effort at natural explanations made by the worldly Greeks dried out completely, the other-worldly Christians seizing upon the religious aspects of philosophy for

the rational justification of their society. The mediaeval scholars maintained the Greek ideal of completeness and logical consistency, their efforts culminating in the 13th century, the century of the schoolmen, one of the most intensely intellectual periods of history. The growth of scholasticism provided the occasion for long training in close, logical thinking, which, while not used upon materials that to us seem profitable, tempered the mental weapons to be used in the later battles of intellectual liberation. "To the schoolmen," J. S. Mill observes, "we owe whatever accuracy of thought and lucidity of logic we can boast."

The second stream, running through Hellenistic Alexandria, bore the only thing like experimental inquiry carried on in the classical world. The Arabs, with a pronounced predilection for this type of work, had there quickly assimilated what the Greeks had to offer on this side, as they also had important acquisitions of the Hindus at a time when interest in Nature had wholly died out in Europe. These things they introduced into the schools of southern Europe. They brought with them three world-transforming inventions—the mariner's compass, gunpowder and paper, as well as the Hindu or Arabic system of numeration, algebra, and the forerunners of modern surveying instruments, the beginnings of chemistry, and most of the ideas of the later Middle Ages at any value in mathematics, astronomy, geography, medicine and natural history.

With the reuniting of the two streams of Greek thought, both enriched by special contributions, there arose the conflict of Arabic experimentalism, with its interest in "stubborn and irreducible facts," and scholastic rationalism, with its critical acumen and Greek gift for generalization. The outcome was that balance between the two that is the scientific spirit and method; the method that provides the effective technique for getting answers to our questions from Nature.

Science first arose in and spread from the universities of southern Europe. Roger Bacon and others in the 13th and 14th centuries showed the dual heritage and exhibited the mental balance and final reliance on experiment that are the pillars of science.

With the 15th century, the change in conditions and ideals, and, above all, the slow accumulation of facts that would not be denied, produced a wide and obvious discontent with the entire mediaeval social and cosmic scheme. There were various significant movements accompanying the beginnings of science at this time and contributing circumstances that made its emergence and open, victorious career possible. I may merely mention the rise of commerce and industry, with widening freedom in economic pursuits and the spread of wealth and leisure; Columbus; Vasco da Gama; Copernicus; the expansion of universities; and the discovery of printing. The emancipation of the individual was the most important contribution of this period of the so-called Renaissance. The real rise of science coincides with the reawakening of individualism.

That universal genius da Vinci showed an almost perfect apprehension of the new method; "Those sciences are vain and full of

errors," he tells us, "which are not born from experience, the mother of all certainty, and which do not end with one clear experiment. Science gives certainty and science gives power. Those who rely on practice without science are like sailors without rudder or compass." Had the results of his work and thought been published, instead of being preserved only in note books, science might have gained a full century. The freedom and humanism of his day, however, soon passed away and science was later compelled to make a fresh start in the face of repression and persecution.

As it was, the 17th century was to prove the crucial one in the development of the new interest, for by virtue of a handful of men of unparalleled genius, who followed one after another, that century was to see the greatest single intellectual achievement the race has yet won. Galileo prepared the way for the miracle, but it was Newton who formulated finally the laws of motion, the law of gravitation and the basic physical ideas which have served so well ever since as the foundation of astronomy and mechanical science. This achievement was the final step needed for establishing in the minds of men the idea of universal law, of the uniformity of nature, and placed science on a foundation where it has been able to follow its open path independently of national boundaries and of social and political changes. Hence the publication of Newton's *Principia* in 1687 "made that date pivotal in the history of science and a turning point in the history of mankind."

The Newtonian principles and methods proved astonishingly successful in dealing with the problems of chief interest in that epoch; and the 18th century devoted itself with unbounded confidence to the analysis of the universe. Science now separated itself from philosophy and has since maintained its course untrammelled by extraneous motives. Thinkers became convinced that the scientific method could be equally well brought to bear in all realms whatsoever, and rendered tremendous service in establishing in the minds of men a new confidence in the stability of the world and in the human reason. The Age of Reason which they so optimistically anticipated has not yet arrived; but science has continued its advance without interruption and pours out its products in ever increasing volume. We cannot now conceive of any retrogression that could possibly bring back the pre-scientific attitude.

THE GROWTH OF SCIENCE

Encouraged by the successes of the 17th and 18th centuries, students turned their attention to the inductive study of the phenomena of the earth's surface, and found more and more in these phenomena the same harmony and the same reign of law that they had first found in the heavens. Never was enterprise more justified of her children. Each discovery opened the way for many others and scientific knowledge and its applications increased in geometric ratio.

"The invention of the method of invention was the greatest invention of the 19th century," for it provides the means of constant progress and reconstruction. What was earlier a sporadic and personal attitude "has become an organized social effect which moves mankind more profoundly than anything else in human affairs." As Pasteur once said: "In our century science is the soul of the prosperity of nations and the living source of all progress. Undoubtedly the tiring discussions of politics seem to be our guide—empty appearances! What really leads us forward is a few scientific discoveries and their application."

Today the world is being transformed so rapidly by science that the next few years may add enormously to knowledge and insight even though we can never precisely foresee the next important discovery or advance. Progress has become conscious, and men base their hopes less on inventions already enjoyed than on those they expect in the future.

From the outset of the 19th century men, in their new liberty, devoted themselves to the pursuit of wealth and were quick to see the practical applications of the new knowledge. More and more Nature rather than Providence seemed to be the immediate source of power and the control and exploitation of Nature through increasing knowledge of her ways has been the most conspicuous feature in the history of our civilization during the last 125 years. All recognize that, in its material aspects, this civilization today is technological, characterized by power-driven machines that have revolutionized the manner of human life. The general picture, from Watt's steam engine down to the automobile, vacuum cleaner and electric dishwasher is familiar to all. Most of what we regard as necessities and luxuries of modern civilizations have come through the application of science to everyday problems. The luxury of to-day becomes the necessity of tomorrow. Progress is continuous, and haphazard methods have been abolished.

Practical recognition is now widely given to the fact that science is continuous with technology and begets modern industry. The value of science in modern industry, commerce, medicine and agriculture is so generally appreciated that all large industrial organizations maintain their own research laboratories with their own staffs of highly trained investigators. There are more than 1500 such industrial laboratories in America, spending \$300,000,000 annually and employing 40,000 research men, and many of these do research in pure science rather than directly upon problems of application.

The distinction between pure science and applied is wholly illusory. But motives of the scientist are intellectual advancement and not the making of something from which financial profit may be expected; and most of the investigations upon which modern industry has been built would have been abandoned at the outset if the standard of immediate practical value had been applied to them. Gladstone, on seeing one of Faraday's famous experiments terminate in an effect which to the non-scientific mind was very uninspiring, asked what possible use his discovery could be. "Why,

Mr. Prime Minister," answered Faraday, "you will soon be able to tax it." On another occasion, in reply to a similar question from an elderly lady, he quoted Benjamin Franklin, "Madam, of what use is a new-born child?"

The seemingly useless knowledge about the laws of force and motion developed by Galileo and Newton and first applied to the seemingly useless matters of the motions of the heavenly bodies was the essential basis for the design of power machines of every sort as well as for many other things. This knowledge preceded the steam-engine, a century of experience with which led to a knowledge of the laws of heat engines in general, which was essential to the development of the internal combustion engine, which in turn made the airplane possible although this outcome was in no way predictable. Leonardo da Vinci is said to have devoted far more time to the problem of flying than he did to painting, but it was necessary to wait several centuries before the development of the gasoline engine, primarily for use in automobiles, made flying possible. Thus the solution of one problem very often has to await the solution of another with which it did not seem to be connected.

The radio and the arts based upon it, today involving commercial values running into billions, are even younger than the automobile, the whole industry having developed since 1910 upon the basis of investigations in pure science principally done on the seemingly useless problem of electronic discharges in high vacuum. The perfection of glass technology made possible the Michelson interferometer, which in turn resulted in an experiment that formed the basis of Einstein's theory, a theory which has revolutionized not only our understanding of physics, but also our entire philosophy. As to research on seemingly useless biological subjects, Professor Thomson says: "A few years ago zoologists were laughed at who solemnly counted the hairs on the backs of flies and quarreled over the specific distinctions between one gnat and another. And could there be for able-bodied men a waste of time more scandalous than cutting sections of entrails of ticks? Yet it has been this sort of knowledge of flies and gnats and ticks that made it possible to open up Africa and complete the Panama Canal." In unforeseen ways every truth seems sooner or later to find its application.

APPLICATIONS OF SCIENCE

Every new invention tends to generate a new industry giving employment to large numbers of men. Think for a moment of the development within the last 30 years of the industries based upon such inventions as the automobile, the airplane, the motion picture, the radio, and rayon, employing together 10,000,000 men or more. The automobile was unknown except as a costly toy before the turn of the century. Today there are 30,000,000 motor vehicles on the roads of the United States alone. Within four decades it has

done such sweeping and revolutionary things to human work and play and life in general that the whole of the modern world has been reconditioned.

There is, as is well known, in every industry following its successful launching, a period of demand and rapid growth, with creation of thousands of new jobs, a settling down with the efficiency engineer working to increase production and decrease costs by mechanizing and stabilizing the processes of manufacture. The result of the cheapening of units by mass production is to make the products often an economic necessity, the number demanded sometimes depending, as in the case of the watch, almost solely upon the population. As a result of the cheapening of products, it is possible for more people to have them and the general standard of living rises. Machines have progressively taken the load off the muscles of the workman, relieved him of drudgery, increased his productiveness and thereby his wages while shortening his hours of work. Before the World War, the average worker turned out \$2,343 worth of products in a year, for which he was paid \$726. Since then industry has been mechanized more and more. The worker now produces \$5,130 per year—and gets paid \$1,345 for it. Our per capita wealth has risen from \$383 in 1850 to about \$3,500 at the present.

In 1900 not one family in a hundred owned a horse and buggy; today three out of four have cars—more than have bathtubs. In 1900 less than 500,000 homes had electricity while 21,000,000 today are wired, the electricity providing many servants for doing tedious tasks at little cost, the per capita use of electricity having increased 15 times as fast as the population growth of the country. 22,000,000 homes have radio receivers, wholly unknown at the earlier period. A mere catalog of improvements and innovations that have come into common use even within the last 20 years would fill volumes, these running from improved rayon, the consumption of which is up 3500% and is breaking down class distinctions, to cheap Diesel engines and baby diets improved so much that dentists and doctors are doomed to less work per 1000 of population. And the prospect for the future is that the same trend will continue at an even faster rate. In viewing the results, can it be questioned that, despite temporary periods of inconvenience and trouble, the modern methods of mass production are desirable?

One is tempted to ask just what the army of men employed as a result of the automobile, telephone, radio, refrigeration and other new industries would be doing if these new developments had not appeared. What we need is much more research to provide the basis for inventions about which new industries to absorb more labor will grow up. A plank favoring the fostering of science and research should be in the platform of every labor organization. Fortunately, in the offing is the possibility of many new materials, such as artificial cotton and woolen-like fibers, plastics and alloys, some of which may in the near future be as familiar and useful to us as rayon and cellophane now are—as well as new inventions such

as television, steep-flight airplanes and those relating to artificial climate making, about which new industries may arise with the possibility of bringing a new era of prosperity. However, the most important results are quite likely to issue from discoveries which cannot now be foreseen.

Anything in the nature of successful long distance planning is, of course, fraught with great difficulty since new discoveries and their many consequences cannot be foretold. J. P. Morgan and Co. refused to buy for \$5,000,000 a block of stock in General Motors Corporation, which subsequently became worth \$200,000,000; and only ten years before the world war Simon Newcomb declared that the problem of mechanical flight by man was impossible of solution. Anticipated social and economic effects of the mechanical cotton picker for which planning has been urged may be entirely voided by the successful production of a satisfactory substitute directly from the cellulose of trees without the intervention of the mule or the tractor and the plow. In the field of artificial climate making, the surface of possibilities has hardly been scratched even though air-conditioning installation had risen from 14 million dollars in 1934 to over 50 million dollars in 1936, with prospects of a large expansion in this business in the future. The development of tray, or soil-less, farming may entirely change the picture of agriculture and its perennially troublesome problems. It is not difficult to foresee in artificial climate making a force which may raise the health level and change production methods in many industries and affect the distribution of population in such a way that even the tropics may be made habitable for a dense white population and offer a temporary relief from the oncoming saturation of population in temperate regions. Many old industries are bound to be greatly modified or entirely superseded; but on the whole the prospect for the next 25 years is that so many more things will be produced at so much less cost that we shall be swamped with abundant life and a multitude of new jobs.

As long as men have unsatisfied desires there will continue the urge for innovation and improvement. America is the happiest, wealthiest, most progressive country on earth because its people are richest in desires and expectations with the greatest freedom to satisfy them. The people of the United States have 7% of the world's population but over 70% of its automobiles—more people owning cars than had enough to eat 150 years ago; they wear 75% of the world's silk; have 58% of the telephones; use 25% of the sugar, 50% of the coffee, and so on.

They are not agreed as to details of what they wish next, though in general looking toward a Utopia of recreation, mechanical conveniences and workless bliss. All are agreed in being dissatisfied with things as they are, so much so that a recent French writer has defined an American as "a man who wants something." This a newspaper writer amends to say "An American is a man who wants something from his Government besides government." It has been suggested that to the average Frenchman an American

is a simple barbarian whose satisfaction in having said "Lafayette, we are here" makes him cease wanting his money back. To the Irishman, "an American is a transplanted son of Erin who feeds fat an ancient grudge by ruling the English with the advantage of not having to learn Irish." While to one large group of our citizens "an American is one who has fought and bled for his country and for whom his country consequently ought to be bled forevermore."

But without the protection and other advantages afforded by discoveries and developments providing biological control, modern civilization with use of most of its inventions would be impossible. The first growth and existence of large cities was possible only through the development of threshable wheat. The increased productivity due to improvements in our domesticated plants and animals together with the introduction of farm machinery is well known. Thus it is estimated that in the United States in 1787 it took all the surplus food produced by 19 farmers to feed one city person, while today 19 farm people produce enough food for 56 urban dwellers and 10 foreigners in addition. As a matter of fact, between 1910 and 1930 the farm worker's productivity increased more rapidly than that of the industrial worker. But the results in medicine have been the most striking in the field of biological control.

Medicine has probably influenced the course of modern history as much as or more than the Industrial Revolution. Our civilization has been able to advance and to hold its gain only through the protection afforded by medical and sanitary science. If deprived of that protection the civilization of every large city would retrograde 500 years and the city might be utterly destroyed. It certainly would be reduced within a few years to a fraction of the present size as epidemics swept the country, and the people would be sickly and short-lived. The population could persist only in sparse and well-separated communities, with the towns limited in size as were the old Athenian cities. Large sections of the world which are now prosperous would become uninhabitable as yellow fever, typhus, the plague and many diseases now almost forgotten returned to decimate the population. Speaking of conquering nations in the last 400 years President A. Lawrence Lowell says that "on the prow of the conquering ship first stood the priest, then the lawyer, then the merchant and finally the physician."

The results of medical and sanitary science are indicated by such facts as the following. In 1870 the death-rate in England and Wales was 22.9, and the infant death rate 160; in 1929 these had fallen to 13.4 and 74 respectively. Expectancy of life for men and women at birth 400 years ago was about 20; 100 years ago 35; today between 55 and 58. The death rate of infants in the slums of England is not one-third that in royal families of the Middle Ages. Most people then died in childhood; so religion stressed the good death, instead of the good life.

INTELLECTUAL AND SPIRITUAL CHANGES

Science is unquestionably the most powerful material factor in the world today. It enables man to escape catastrophe on land and sea, to stay the famine and prevent the pestilence, for which the earlier desperate expedients of magic and supplication were wholly unavailing. But all these material results which have thus brought increased security and satisfaction to the masses of people, are not so important as the intellectual and spiritual changes which have come along with them. Its great influence has been in emancipating the mind and making it possible for intellectual life to prosper under a new standard of morality and a new outlook upon the world.

The method from which these world-moving results derive is that disciplined type of thinking in which the object of thought is subjected to controlled observation and experiment, as free as possible from emotion, for the most destructive influence within science is emotional bias. In other words, it means submitting our ideas or hypotheses to the authority of Nature, acknowledging with Emerson that her laws are inexorable, that she tells no falsehoods, that "everything in nature, even motes and feathers, go by law and not by luck, and that what a man sows he reaps." The basic position is that all our ideas and thoughts derive from some phase of the common sense which assumes the reality of the objective world. In that assumption is bound up the sanity of man and the integrity of science. And "thus far every attempt to transcend the world of experience which common sense describes has met with failure, for all the thought which such attempts involve is couched in the imagery of these experiences." Scientific thinking is thinking in the service of the principle of truth or reality rather than in that of pleasure. Practiced by only a small fragment of the race, it has proved fruitful beyond our wildest expectations. It has given us the truth by which we can live and live more abundantly, and its livableness is its best test.

On the contrary, emotional or wishful thinking — "thinking hobbled by fear, desire, aspiration or self-exaltation" — has been sterile or destructive because involving a greater or less departure from reality. Much of such thinking may be comparatively harmless; but such excessive departures from reality as witchcraft, which during its long and ghastly course is said to have destroyed no less than 10 million lives, and the religious persecutions and nationalisms which have destroyed many more millions, belong to the domain of insanity and crime.

Persistent departures from reality are made in aid of established power. The interests of those in positions of authority call for the support of thought which, unfortunately, in being so applied does not have to correspond with the facts but rather with the ideas upon which the authority rests. The question is no longer one as to the intrinsic validity of the thought, but one as to its bearing upon the sanctions of the power or authority. That becomes

the criterion to which every idea or judgment is subjected. All that upholds the established authority is good, and therefore true; all that tends to weaken it is bad and therefore false. The primary purpose of intelligence is thus diverted and frustrated.

The essential characteristic of scientific technique is that it proceeds from experiment, and demands objective criteria. Science believes in salvation, not by faith but by verification. To practice it we must subordinate all other motives and whatever may have meant most to us to the love of the truth; and "we shall find truth only upon that wide-open but almost untraveled road which leads away from ourselves." Love of truth, without passion or prejudice or predilection, is the first principle in the ethical code of scientists, one of whom has recently said that the Decalogue of Moses might be accepted as the Decalogue of Science if the word "Truth" were substituted for the word "God." All the progress we have won has depended upon truth, and the acquisition of this truth upon intellectual honesty.

For ages the idea of truth in common thought has been that of something absolute and final, "a light planted in eternal principles and shining upon our path." Every such idea of absolute truth, however, has failed in some phase in the test of new knowledge and progressive living. In contrast with this way of thinking, to the scientist what is regarded as truth at any particular time is not likely to be final. The best a finite mind can achieve is but a dim outlining of what may be in a final cast of thought the ultimate in the relations of reality and mind. "Truths emerge from facts, but they dip forward into facts again and add to them, which facts again create or reveal new truth." What we call natural laws tersely summarize our experience of the world at a given time and endow us with a gift of prophecy that points the way to new advances.

Difficulties are to science the stepping stones to higher ground. When it was found that Uranus did not follow the calculated orbit, the result was not abandonment of the theory of gravitation, but the discovery of Neptune. When it was found that nitrogen prepared by different methods yielded different atomic weights, the outcome was not the breakdown of chemical theory, but the discovery of argon, and later, of isotopes, thereby increasing the range of chemical knowledge. Similarly today, the impossibility, by existing means, of measuring precisely at the same time both the position and the momentum of a particle within the atom,—designated as Heisenberg's principle of indeterminacy—is not a denial of causation but an opportunity for further research. Certainly the principle is no valid argument for freedom of the will in view of the fact it does not apply to molecules and aggregations of these of which living things are always composed. In the growth of real knowledge a contradiction is the first step toward a victory.

We all stand in the midst of a continuous accretion of facts and experiences and the evolution of truth. The body of human knowledge is forever incomplete, but forever growing. We can see no possible end to its expansion, no prospect of its becoming final. Thus the vitally important thing is not this or that scientific discovery or the materialities of life that flow from it, but the attitude of mind, the mode of thinking without trammel, that makes for the discovery and acceptance of new truth.

“I am part of all that I have met;
Yet all experience is an arch where thro’
Gleams that untravelled world whose margin fades
Forever and forever when I move.
How dull it were to pause, to make an end,
To rest unburnish’d, not to shine in use!
As tho’ to breathe were life! Life piled on life
Were all too little, and of one to me
Little remains, but every hour is saved
From that eternal silence, something more,
A bringer of new things, and vile it were
For some three suns to store and hoard myself
And this gray spirit yearning in desire
To follow knowledge, like a sinking star,
Beyond the utmost bound of human thought.”

—*Tennyson's Ulysses*

As to any final meanings, science requires a hardy renunciation. What can be known, let us seek with all vigor and honesty of means at our disposal; what cannot be known, let us face fearlessly and no less honestly. There clearly emerges then this profoundly significant fact: our entire modern civilization rests upon a technology which has grown out of pure science, which is dependent upon a race of men who deliberately and unswervingly refuse to consider their own “desires, tastes, and interests as affording a key to the understanding of the world.”

The biological purpose of intelligence, namely, to achieve adaptation to the environment, is defeated if an erroneous belief is held, for belief in unreal things closes instead of leaving open the way to new adaptations. Yet error is common because belief is the easiest way for the mind. It seems as natural for the mind to believe a thing asserted or suggested as it is for the senses to feel or sense, as every professional advertiser and politician well knows. There is no physiological equilibrium unless the mind comes to rest in a conclusion with reference to a series of conditions before it. The untrained mind reaches conclusions quickly, for this is following the line of least resistance; and superstitions represent beliefs adopted to free the mind from the strain of uncompleted thinking.

Open-mindedness, with suppression of vanity in quest or argument, freedom from unquestioned traditional tenets, and an ideal of impersonal and unselfish search for truth constitute the core of the scientific spirit. It requires suspended judgment in the absence of adequate evidence, and it demands freedom from all authority other than the supreme authority of Nature itself as interpreted by the collective scientific intelligence. Thus science is a social enterprise and the best example of successful cooperation we have. James refers to this cooperative nature of science when he speaks of the "thousands of disinterested moral lives of men buried in the mere foundations" of the edifice of science and of the "patience and postponement, the choking down of preferences, the submission to the icy laws of outer fact wrought into its very stones and mortar."

If there had been no Galileo there would have been no Newton and it is equally true that without Newton there would have been no Galileo. What Einstein has achieved was possible because of the prior work of Minkowski, Fitzgerald, Lorenz, Michelson and others, without which he could not have developed his relativity theories. The most important results of scientific research are given to the world with no thought of profiting from their possible applications and often without luxuries, or even necessities, in the lives of those responsible for them. As a result of its underlying method and ethics science has become international and completely democratic.

SCIENCE AND FREEDOM

Science arose in a period of breakdown of older authority and of an emergence of wider individual freedom, and its existence is dependent upon continuance of conditions that permit thinking without trammel. The question of freedom, therefore, is a particularly vital one to science at the present day, when in some countries under dictatorships the right to seek, verify and openly proclaim the truth has been stifled, in some cases, it is said, with a cruelty more intense than anything western civilization has known in 400 years. Science depends upon freedom; but, in turn, during those 400 years science has been the most important factor in bringing the larger human freedom, both in body and mind, we have enjoyed.

Every ancient civilization was built upon a foundation of slavery, for human muscle was the only source of power they possessed. Slavery and civilization were synonymous. When the Egyptians needed bricks, they enslaved the Hebrews; and, as Dr. Whitehead suggests, "the confusion of tongues associated with the Tower of Babel . . . is at least well-founded as a reference to the confusion of races amid the slave population supplying the mechanized man-power for the building of cities." For a thousand years or more of classical Greek and Roman history the civilized apex of society rested upon a foundation of slavery. A sudden abolition of slavery at the time of Augustus would undoubtedly have meant the collapse of the whole social system. Plato's concept of the human

soul and its natural rights was readily assimilated by Christianity and has had a long and beneficent history in its influence on religion and social theory; but neither Plato nor Marcus Aurelius nor the high-minded Stoic lawyers ever started a campaign against the compulsory degradation of human beings in slavery because the institution was presupposed in the very structure of existing society. The victory for the extirpation of slavery came only when science through the harnessing of natural forces rendered recourse to slavery unnecessary.

A few illustrations of the way in which human muscles have been relieved may be given. The compressor machine enables one man to break up as much street pavement as eight can do with pick and shovel. The power corn-sheller enables one man to shell 720 bushels in the same time that eight bushels can be shelled by hand. A modern bakery turns out 2,000 loaves of bread an hour with a force of eleven men. A new automatic machine turns out 100 times as many table tumblers per man per hour as can be produced by hand. With a new spiral conveyor 18 man hours are now sufficient to unload a shipload of chemical fertilizer where 720 man hours were needed before. Machinery hitched to the photoelectric cell is relieving man of the exhausting monotony and tediousness in many jobs, and freeing him from many dangers. The miraculous electric eye sorts beans, lemons, peaches, raisins, cigars, checks and bills; it analyzes card records; detects missing labels; candles eggs; grades tiles, vegetables, tin plates; counts traffic, people, animals and so on; and it inspects numberless other things. No limit can be set to what may in the future be done by machines.

The load lifted from human backs by the introduction of power-driven machinery is strikingly illustrated by Professor Moulton who says that "the coal burned in the United States each day does more mechanical work than all the men in the country do in a year. Every person in the United States has 10 horsepower of mechanical slaves working for him—equivalent to 400 million slaves altogether. A ton of freight is carried a mile on railways at a total cost to the shipper which would buy the time of an unskilled laborer for only a minute or two. A 60-watt electric light is operated for almost an hour at a cost to the user of the federal tax on just one cigarette." Not many years ago the working day in most factories was 12 hours long for six days a week, or 72 hours for the week. This working period has fallen steadily to approximately 40 to 44 hours a week of 8 working hours a day. Only time and technical developments will tell how much shorter this is to become.

Thus science, by its conquest of force and space has enormously lifted life in its qualitative aspects. Men work less, produce more, consume more, and enjoy more education, goods, leisure and opportunities, especially in industrial countries where initiative has had most play and reward.

The conflict for intellectual freedom in which science has been involved since its emergence 300 years ago has been a conflict primarily of methods. It has not been a conflict between Truth and

Error, or Science and Religion—it has been a continuation of the age-old conflict between Rationalism and Irrationalism. Each step forward has been taken through a corresponding measure of liberation from the authority of traditional belief and the power it serves. For the social tradition not only brings to us as a legacy the cumulative experiences and achievements of intelligence, it likewise transmits the fruits of human effort to out-reach intelligence. The racial heritage is thus not only a priceless storehouse of knowledge and experience; error and superstition are likewise embedded in the tradition. Great as the natural disabilities of the intelligence are, and great as are the natural difficulties of its tasks, they are slight beside these obstacles of man's own creation. In the age-long struggle for the freedom of the human spirit, the greatest issue has derived from interests which have deliberately placed blocks in the way of the free operation of intelligence.

The outcome of this conflict in behalf of rationalism and freedom of thought is significant, and has been "fought out in the bitterest, most cruel and most protracted struggle that the human spirit has ever undergone." It is too much to say that the reign of reason is at hand, for most of us are still primitive, and do little sustained thinking; but the number is growing year by year, and there is ground for the hope that the rational is henceforth destined to displace the irrational in the command of the motive forces of conscious conduct.

SCIENCE AND DEMOCRACY

Science is concerned today over the present world-wide threat to democracy, which is on what I believe to be a temporary defensive. Science is the natural ally of democracy. It has fostered the growth of the democratic ideal; and democracy offers the type of government which is a necessity to its free development. It is opposed to repression and to dictatorships, under whatever name or guise. In Germany, where Hitler claims complete power over every phase of the citizens' lives and yet tells them he has given them "a beautiful democracy," merely count the distinguished scholars who once brought fame to her and to her universities and how few remain there, if you would know to what condition her once great and free educational centers have been reduced. As President Conant has said, "Liberty is the life-blood of those who are in the quest of truth, and liberty has vanished. So in Russia it vanished nearly a generation ago. In these countries the advancement of science is permitted, but within strict bounds; a free inquiry on any subject is, to say the least, hazardous."

The liberal tradition cannot survive in a climate unfavorable to free inquiry and expression. For those who really care about freedom, choice of government can lie between two forms only, democracy and dictatorship. Totalitarian government undoubtedly makes for a temporary efficiency in the achievement of known objectives, as in the case of war, but that efficiency is effected by the

suppression of all divergencies in ideas and efforts of individuals. It is precisely from these divergencies, however, that progress and new objectives arise. Better continue to muddle along somewhat uncertainly and slowly, where the future in knowledge and needs and objectives themselves are necessarily uncertain, than to close the gate to progress and adaptation. The ideal of democracy which would seem to rise naturally from the scientific spirit and attitude is one that aims to foster the full and free development of men and their ideas with the concession of relatively great scope to the best men interpreted in terms of the interests of the race as a whole. Advance in the past has come from the energy and personal ambition of innumerable men and women. We must not halt progress by taking away their freedom and their incentives.

John Dewey has said that we may justly attribute most of humanity's sorrows and defeats of the past to the futile and destructive oscillation between authoritative power and unregulated individual freedom. People have preferred authority and stability to freedom, on the whole; but an unchanging stabilized situation in this world of flux is always an illusion. "In spite of possession of power, and in spite of the persecution of heretics and radicals, no institution has in fact had the power to succeed in preventing great changes from taking place." Authoritative damming up of the forces of social change has merely meant that the forces so accumulated have later manifested themselves in more violent eruptions.

The remedy does not lie in abolishing either freedom or authority, but in establishing a rational basis for interrelating them. It cannot lie in more drastic doses of old remedies; and we certainly cannot expect relief from the same sources—industrialists, capitalists, politicians, and others—who have so clearly demonstrated their ineffectiveness.. What we need is not a superman or a greater concentration of power in individuals or bureaus or planning bodies of the old sort, but the thorough-going application of the method that has been used with such remarkable success in science. We must somehow find a way to apply this method to economics, government, international relations and human affairs in general. Today science, rather than legalism, offers the means of triumph in the future.

The great weakness of the historic movement in behalf of liberalism has been, Dewey says, "its failure to recognize that the true and final source of change has been, and now is, the corporate intelligence embodied in science." All the economic changes of recent centuries have been the fruit of science, a perfectly operating democratic institution in which both the power and the authority rest in the collective, cooperative intelligence.

The extension of this method to the political, economic and ethical relations of men is fraught with great difficulties and has thus far been depressingly slight, because in these fields the human reason is still largely enslaved by prejudices.

The ways and means of promoting such extension of a free scientific attitude and procedure in these social fields constitute the outstanding and basic problem confronting us. A first step would seem to be the open recognition of the limitations indicated and an honest analysis of the prejudices setting these limitations. This would purge the studies of seeming chaos and save their students from confusion. The outcome of this extension can only be the attainment of the great society of which men have dreamed, culminating in an organized world-state. Nothing but a catastrophe that will destroy the scientific trend and annul the biological process that antedates and underlies this trend, with a consequent lowering of the whole level of civilization, can prevent this denouement. Such outcome could only mean an era of world-like peace and happiness in which much of present human tragedy would be abolished. Present trends point to a cloud on the horizon which may portend a dark period of restricted liberty; "but any attempt to uproot and eliminate the principle of individual freedom in behalf of the assurance of security and attainment of solidarity by means of external authority is doomed to ultimate defeat no matter what its temporary victories."

SCIENCE AND SOCIAL AFFAIRS

The hopes freedom and liberalism seemed to hold out for the race have not been fulfilled; and it has become increasingly evident that control over the physical forces of nature has widely outstripped man's control over himself. The situation in social affairs may well fill us with dismay when we consider how little headway the critical scientific attitude has made among the general run of people. We are confronted by the danger suggested in the ancient passage: "For want of knowledge, the people perish." For the most part people do not now believe in ghosts and witches; but they are still excessively credulous and do believe the best advertised notion, whether it be a soothing-syrup in New England or a social panacea in California. The charlatan, pseudoscientist and demagogue are closer to them than the scientist or expert.

The human situation today corroborates Huxley's observation that "a man's worst difficulties begin when he is free to do as he likes." Liberated from the restraints of drudgery and of much of tradition, he is the plaything of opinion, propaganda, fashions and fads, and has made the popular newspaper, moving-picture and radio what they are. Freed from the ravages of famine and pestilence, he sacrifices millions of men in a futile war-world, using his immensely increased power to achieve primitive, irrational ends. We have laws to prevent the spread of bodily infections, but we have no regulations to prevent the distortion and infection of the mind with erroneous ideas and doctrines. If we are to survive at the present or a higher level, the time must soon come when beliefs and the factors determining them will be treated as the most important problem of public health, understood as concerned with both body and mind. Only the pro-

phylaxis of the scientific method as a corrective to undue subjectivity and wishful thinking gives any promise of enabling the individual and the group to deal sanely and soundly with those vital social issues upon the management of which the special significance and value of human life depend.

It is not meant to say that substantial results have not been secured toward putting social studies on a scientific basis but that, in spite of the worthy aims of students, progress in this direction has been limited and applications largely nullified by the fact that these studies are so largely conditioned by beliefs and strong prejudices emanating from dominant social organizations and the philosophies they create in their defense. A superimposed relationship thereby comes to obscure and distort the true situation. The result is that in these studies there appear definite divisions or schools whose adherents not only condemn their colleagues of contrary views but combat them with all available methods, including prisons and torture in some countries, such as Germany. Thus progress in these fields is marked by strong controversies as contrasted with the pure sciences, such as physics, chemistry and most branches of biology in which there are not these militant divisions among the experts themselves.

Even in some phases of biology that approach or are involved in social problems, prejudices,—economic, political, religious and psychological—enter in to obstruct a free application of scientific method, with the result that distortion of facts and dishonesty are frequent. There is very high promise for a safe and effective sociological synthesis and program on the basis of results already achieved in psychology and genetics; but the difficulty of making substantial progress here among the people, by which our officials and rulers in time would be made aware of the realities, is extremely great. This may be brought home by considering that the mere use of such expressions as “genetics in relation to society,” “birth control,” “inheritance of acquired characters,” and “differences in racial mentality” is almost certain to lead to more or less heated discussion, not on the basis of pertinent evidence, but on the basis of emotional reactions often arising from attitudes and mores acquired in early youth. In such discussions we may see how easy it is for subjective elements,—preconceived notions and philosophic speculations—and the accompanying emotional bias to confuse factual evidence and to distort scientific thought in behalf of preferred interests. Bruno was not burned by astronomers nor was the controversy over evolution a biological one even though many biologists participated in it.

It is a fundamental postulate of modern science that man is part of nature and that his body, mind and social relations are subject to laws which may be studied comparatively and scientifically. To seek to solve his problems on any other assumption is futile. We have been released from fear of finding the truth about physical forces. We must become free from the fear of knowing the truth about ourselves. The recognition of man's solidarity with Nature is an indispensable basis for acquiring any accurate information about

ourselves, and the fact that this premise has been only so recently adopted accounts for the little, comparatively, that we do know about man and the little that has been accomplished in the way of needed social reforms that look toward a happier future for the race in the light of a clear understanding of his past, his limitations and his possibilities, including those in the field of intelligence, social sympathy, cooperation, ethics and purpose, for these are natural manifestations, have had a natural evolution, and are proper objects of scientific study.

Bertrand Russell is wholly wrong, I think, when he asserts that the sphere of values lies outside science, for no change in method is justified when we pass from facts of existence to facts of value. As Professor Thorndike says: "The world needs the insights and valuations of great sages and dreamers. . . . But it also needs scientific methods to test the worth of the prophet's dreams, and scientific humanists to inform and advise its men of affairs and to advise them not only about what is, but about what is right and good."

The material changes wrought by science have necessitated new morals and new ethics because new, far-reaching and unforeseen consequences now arise from our actions. "When it became known that leprosy was caused by bacteria and not by devils, the words right and wrong took on new meanings for every leper. It should be obvious, then, that ethical codes must change as knowledge and civilization change." Hence, as John Dewey has said: "The vanity and inexpansibility of values that are merely *final* and not also means to the enrichment of other occupations of life ought to be obvious." The process of growth, of improvement and progress rather than the static outcome and result become the significant thing. "Growth itself is the only moral end." Not perfection as a final goal, but the ever-enduring process of perfecting, maturing, refining is the aim of living.

What we have come to understand as progress has depended wholly upon the truth as ascertained by the application of intelligence. The achievement of control through knowledge has already justified itself in the field of conduct. Morals are being taken over by the rational intelligence and, it has been said, for the first time we are clearing our moral slums efficiently because we know how. Charity is not now a mystical virtue through which the individual accumulates merit, but it is a problem and obligation of society itself to be gone into as a business. The moral deviations that have scourged mankind have not been matters of depraved conscience, of lack of moral sensibility, or of broken commandments; all resolve themselves into an irrationality which has permitted the establishment and growth of wrong. Every liberty we enjoy, every freedom from wrong, is the outgrowth of some intellectual truth, and no error or untruth whatsoever can "contrive to be inoffensive." Thus the distinction commonly drawn between the moral and the intellectual is a fiction or illusion.

Established opinions of various ages have permitted and supported every crime under the sun. If those opinions be bad, no degree of conscientiousness or of enthusiasm for virtue, however well-intended, can make an individual's attitude good or right. There is ground for the hope that the intelligence, young as it is, is already sufficiently manifest in social affairs that any effort to thwart it is going, sooner or later, to react disastrously upon whatever person, people, or institution tries to do so.

EUGENICS

A new ethical principle is growing up with the spread of the scientific attitude and method which emphasizes the fact that relations of society today are not in the main individual, for it is permeated through and through with corporate relations of many kinds. Science is coming to have little use for the ideas of guilt and punishment such as underlie the common abuse of the insanity plea. As Dr. R. A. Millikan has suggested, in time individuals will be called upon to sacrifice and suffer for the good of society without society's having to show that they deserve to suffer. In this new ethic the service of all mankind is the universal good. Furthermore, in considering the greatest good of the greatest number, full consideration and rights must be accorded to generations yet unborn. We cannot justify the position of the man who refuses to do anything for posterity on the ground that posterity has done nothing for him. Our supreme obligation to the race is to do what we can to further its progress.

The advance in science and civilization may well be checked by the present level of intelligence; but there lies hope for continual advancement in knowledge and improvement in culture in the biological probability that the human species has not reached its limit with respect to intellectual ability. In fact, the biologist, in the light of man's past, sees his future optimistically as presenting almost unlimited possibilities. Man has the means of consciously determining his own future. That future is, for weal or woe, in his own hands and is his own responsibility.

Professor Scott Holland of England has remarked: "To say that a man cannot be made good by an act of Parliament is such an obvious truth that people forget what an outrageous lie it is." In this paradoxical statement he is calling pointed attention to the fact that what matters is the relationship of any governmental social scheme to man's capacities and desires. Both human nature and human nurture are potent and subject to improvement. But our attention to the externalities of the human situation has been too exclusive and hence the statement of a recent critic: "The most alarming symptom of our sick civilization is that the one searing question which needs immediate answer is virtually never asked. What is the matter with man? All the social doctors are fussing with the irrelevant secondary symptoms of an undiagnosed human degeneracy—the breakdown of free institutions, the disruption of decent human relations, the inadequacy of economic systems. Our

species includes a very large proportion of individuals who are eager, at any personal sacrifice, to spend themselves in promoting the betterment of their fellow men. Ingenuity, ideals of service, intelligence, a sifted and refined mass of traditional knowledge, techniques of scientific experimentation—all of these are available for man to improve himself, and he has tried to improve everything else except himself.”—*Hooton*.

The result of man's smug content with himself is a portentously increasing mass of mediocrity and degeneration under the load of which his Utopia may collapse. In every age the tragedy has been repeated. An able people achieves a high culture and civilization, but in doing so provides conditions that favor the preservation of the inferior and that attract hordes from the outside by their promise of an easy living with a minimum of risk, quite as the same grade have been drawn to America. A principle long ago pointed out by Darwin, namely, that those organisms reproduce most prolifically who have least to transmit to offspring, holds for man. Inferior strains reproduce at double or more the rate of the more intelligent. They swamp the declining better stock, and ability no longer is produced in adequate supply to sustain the civilization. The unintelligent strength of numbers asserts itself and in the end another historic demonstration is given that a government “of the unfit, by the unfit and for the unfit cannot endure.”

The menace to racial welfare in all lands is this relative infertility of the superior types. The outstanding fact is that the ancient dysgenic process which has played a continuous role in tumbling state, race and civilization into a dusty heap with periodic certainty has been greatly and dangerously accelerated in our own day. In the face of our growing human difficulties many are lending a helping hand and are putting good-will, energy and enthusiasm into the work; but they are relying almost exclusively upon social regulations and laws with a disregard of the innate qualities of men that threatens disaster. They are too largely ignoring an obvious disharmony between social progress and biological progress. It has been said that our social engine has stalled. “A succession of political, economic and sociological drivers have been pulling and pushing every movable gadget in a futile effort to make it start. May not a biological bystander suggest the possibility that someone has put water in the gasoline?” Unless a race, while its liberties are increased, at least maintains an organic foundation capable of yielding the quality of sanity and capacity for productive work and for the achievement of satisfaction, anything in the nature of social evolution will fail.

The world is being filled up with human beings through an unprecedented rate of population growth made possible through the applications of science. The saturation point, however, is not far ahead. Before any stability in population is attained we are probably doomed for such conflict, suffering and disaster as we have not yet known, for we are probably living only in a lull before an inevitable clash of peoples in a madness growing out of population pressure. This might be avoided by recourse to forethought, but the prospect

is that adequate thought in this matter will come only under the compulsion of events. Until they have to, most people avoid thinking, especially on unpleasant and long-range topics.

When it becomes evident to people that a stabilized population is inevitable, they will perforce think of progress no longer in terms of bigness or quantity but in terms of quality. When they do, a new era in the development of the Kingdom of Man will have dawned. They will have learned that no construction of society, however precise, will automatically bring the millenium. It is not the machinery of life, but life itself with its capacities and purposes that is primary, and the "millenium, like the kingdom of heaven, is within us." The machinery must be commanded by ability and purpose to become a means to new realms and new life. It is faith, not evidence, which encourages some educators, social workers and economists to hope so greatly in the ameliorating effects of the conditions of life, while ignoring the basic fact that equality of ability is a biological impossibility.

There can be no ultimate solution of any important social or governmental problem, national or international, in which applied eugenics does not have an important role. No doubt for a considerable time men will continue to try legislation or other measures of betterment before they recognize this fact. But unless we soon rigorously apply to ourselves and our various social activities and institutions the scientific method, every further step forward in science will bring additional hazards. If and when such application is made thoroughly and whole-heartedly, the dangers and pitfalls in man's forward path will disappear by being clearly seen and understood. Then the people, recognizing that the new power is harmful only in so far as man is foolish but beneficent in so far as he is wise, will become "fervent disciples of a new social faith upon which a lever made in the workshops of natural knowledge may be placed to move the world."

EDUCATION

Everything thus points to education as the necessary first step in any program of betterment. Present-day education is inadequate, though vastly better, in both trend and substance, than any that could result from following the incredible proposal of President Hutchins that we return to the subjects of the good old classical learning. On the contrary, what we must have to enable us to live well in this age of science is, along with other things, a more widespread and more thorough-going instruction in grade A scientific subjects, and in the ethics of science.

We cannot any longer educate children in any final or detailed way for the world as it is, for by the time they grow up the world will have changed. Nor can we educate them for the world as it

will be 25 years hence, for no one can foretell what it will then be like. We must educate them to expect change as the only constant thing in life, to welcome it and to assimilate it as it comes; for the only security we can look forward to is that found in ideally controlled progress. The crucial test of the success of education should be an inclination and capacity for indefinite growth; a growth social because participating in the best life of the world. The prime function of education, in other words, should be to prevent that great and widespread tragedy of life, the closure of a mind at the threshold of what might have become a great adventure, condemning it to go through life immune to new ideas or new attitudes.

Thus the end of education is not the mere acquisition of knowledge but the achievement of a point of view, of an attitude toward life and an orientation to the world. Everywhere the most urgent educational problem should be recognized as the broad inculcation of scientific method and understanding, as inducing the habit of independent, rational and equable thinking, the habit of relying upon accurate information and tested facts, upon observation and experiment rather than upon authority and precedent, the habit and capacity of keeping abreast of the latest findings. The prospect of the spread of this spirit inspires the hope that a stop may be put to the teachings of prejudices, with the students not only desiring to know but desiring to know the grounds of knowing.

The dissemination of this spirit must proceed primarily from our universities, in the hands of which, as the chief bulwarks of freedom and democracy, some see the fate of the intellectual civilization of the world. Through their agency we may hope the teachers of the public schools will become better and better trained in science and prepared to spread the infection of its spirit. For, as Walter Lipmann notes, "the ultimate question is not how the populace is to be ruled, but what the teachers are to think; that is the preface to everything else." There is not a problem in the world today which honest thinking cannot solve, not a danger it cannot effectually cope with.

In regard to propaganda, not only do its interested agents fail to exhibit that rare quality, love of truth, but all too often they devote themselves to a consideration of the relative expediency of different falsehoods. Unfortunately, the truth is not always essential to success in attaining the objects of everyday life, and there is some justification for the view expressed by Anatole France, in accounting for the unpopularity of the truth, that the truth is inert, is not capable of modification, is not adapted to the machinations which would enable her to win her way into the hearts and minds of men, while error possesses the most wonderful resources and adaptabilities.

The printing press has long been a most important agent in the spread of knowledge and the habit of rational thought, but it has become equally available for the spread of error and as an impediment to the rational attitude. We may justly resent direct misrepresenta-

tions carried by the press; but this is hardly so dangerous as the persistent effort to influence public opinion by subtle means of propaganda. The spread of such propaganda in earlier days through books, pamphlets, isolated newspapers and public speakers was comparatively slow. Today some of the new inventions make for speed and directness of communication and have far surpassed the newspapers in importance as means of propaganda and emotional appeal. The moving-pictures and radio can stir and mobilize with incredible speed public opinion and that dangerous power—mob emotion. By such means we have recently seen the peoples under dictatorships in a remarkably short time brought to a unified way of thinking. An English statesman is reported to have said recently that he considers the radio and the moving-picture to be the two most dangerous inventions, not forgetting the engines of war which come into play after mass emotion has been roused. The impending perfection of television will add greatly to these agencies. As a result, changes in ideas and institutions may in the future be brought about with a suddenness that will be appalling.

The dangers from the misuse of these agencies of propaganda can be combated only by a widespread critical attitude backed by the will to reach the bottom of things in spite of all selfish motives that may tend to obscure the issues. The basic need here is the promotion and practice of that rigorous, intellectual honesty upon which truth depends, for social progress and effectiveness, in turn, depend upon that very truth. Speaking of this spirit and method spreading from science, Dr. Whitehead says: "This balance of mind has become part of the tradition which infects cultivated thought. It is the salt which keeps life sweet. The main business of universities ought to be to transmit this tradition as a wide-spread influence from generation to generation."

CONCLUSION

"When all criticism is done," says Whetham, "we cannot but pause, wondering and amazed at the majesty of the temple of science. Whether we stand within . . . or pass without and trace the success with which it interprets . . . we are equally fain to confess that it is the grandest work of the human intellect . . . It stands a triumph of truth and patient perseverance, and an eternal sanctuary for the human mind."

Modern culture has come into being through science and the control of the forces of Nature which it has yielded. The rationalistic spirit of science is the spirit moulding the modern world, its implication being not so much the importance of any particular truth as the right to seek truth and to extend it unhampered by restrictions or

authority other than that of Nature herself. Through science man has ceased to be the plaything of blind forces. No longer does he face his world with haunting fear resulting from taboos. He faces it directly with the knowledge that Nature is friendly, dependable and understandable—not the expression of an unknown and capricious power intent on working him ill. He may indeed be on the knees of the gods, but these gods do not help him to his desires; he must help himself by understanding Nature and by ordering his life in conformity with her ways. In the light of past achievements, optimism and courage are justified as we work out our destiny with increasing self-consciousness and with a wider perspective. In spite of many discouraging situations and past disappointments, with the recognition of man as part of a plastic and growing nature, neither the beginning nor the end of which we can see, we may hope there is a time ahead “which shall prove that the visions of the young and the dreams of the old were prophetic of a glorious reality.”

Tennyson, perplexed with the growing fear that the universe of which we are a part may be largely or wholly organized without reference to the needs of men, expressed a prevalent religious tendency of his day to accept as mysteries the things not understood when he wrote:

“So runs my dream: but what am I?
An infant crying in the night:
An infant crying for the light:
And with no language but a cry.”

Today the attitude is to face the unknown, not in the spirit of passive defeatism, but with courage and with the adventurous confidence of hope, in the spirit of Louis Untermeyer's Prayer:

“Ever insurgent let me be,
Make me more daring than devout;
From sleek contentment keep me free,
And fill me with a buoyant doubt.”

There is a changed philosophy of life that has come with the spread of the scientific spirit and its expression in the progressive modifications in thought and in its products that have all but miraculously ameliorated the physical environment and the intellectual relations of civilized men. The emphasis today is upon the life here and now, upon the importance and righteousness of human happiness, upon the real values that inhere in the self-satisfactions of human life. Devotion to a realization of the *Imperium hominis*, the Kingdom of Man, Bacon wrote of, claims our major thought and effort.

“We men of earth have here the stuff
Of Paradise—we have enough!
We need no other stones to build
The stairs into the Unfulfilled—
No other ivory for the doors—
No other marble for the floors
No other cedar for the beam
And dome of man’s immortal dream.
Here on the paths of every-day—
Here on the common human way—
Is all the busy gods would take
To build a Heaven, to mold and make
New Edens. Ours the task sublime
To build eternity in time!”

—*E. Markham*

The history of human progress is a story of emancipation, and its course has by no means been run. The future of the race is in all likelihood to be a scientific future, since science gives the truth needed in actual life and furnishes the means for advance, every achievement enlarging the field of subsequent possibilities. Nothing can stop this growth except suppressions of freedom. Man’s future progress must depend upon the very degree of intellectual honesty he brings to bear upon the problems that confront him; for these problems whether social, economic, emotional, or ethical can be effectually met and solved by no other means than by honesty of rational thought. That is the one and only guarantee of future progress.

Wordsworth long ago queried:

“Man now presides
In power where once he trembled in his weakness;
Science advances with gigantic strides,
But are we aught enriched in love and meekness?”

In regard to the problem raised here, it may be repeated that the advance of social justice has been brought about and conditioned by exactly the same methods of intelligence as those which led to the creation of the radio and to the elimination of yellow fever. Everything we call precious has been wrested by the power of human intelligence from the dark chaos of mystery and brutality. The things man prizes as most worth while are the fruits of his own toilsome effort. The connection of the moral progress of the modern age with its scientific and material achievement is not accidental. Both the material changes and the moral changes proceed from identical causes. The eradication of the horrors and ferocities of Mediaeval feudalism and despotisms resulted from the same intellectual criticism that led to the collapse of the Ptolemaic system of astronomy.

It has been shown that the aims and results of science are humanitarian. Science is solicitously concerned with the problems of race betterment and human cooperation; with the promotion of truth and justice and the spread of ethics among men. "Its religion," says Barry, "is a religion of things as they are, which translates hope into purpose, and prayer into work for the betterment of humanity here and now." Religion itself among us has become largely secular in that it is devoted more and more to the problems of social improvement; and, as Conklin suggests, "If the humanitarian aims of both science and religion could be viewed in the spirit of sweet reasonableness, it would be seen that the differences between them are not such as to prevent fruitful cooperation in promoting human welfare."

St. Augustine's dream of the City of God has not been realized. The new city is an earth-conditioned city. "It gives up ideals," says Shotwell, "that suited a world to come for practical politics in a stern present. It is less interested in heaven and hell than in sanitation and unemployment. It is cleaning streets and tearing down slums. Even its evils are frankly human. We have no illusions about these things. They are ours for better or worse. We are responsible for them, and know it. We can no longer escape by claiming that its good or ill are God's or Satan's. The City of Civilization is in our hands; and the knowledge that it rests with us to make it fit to be the symbol of either is the inspiration to make it worthy the dignity of man."

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